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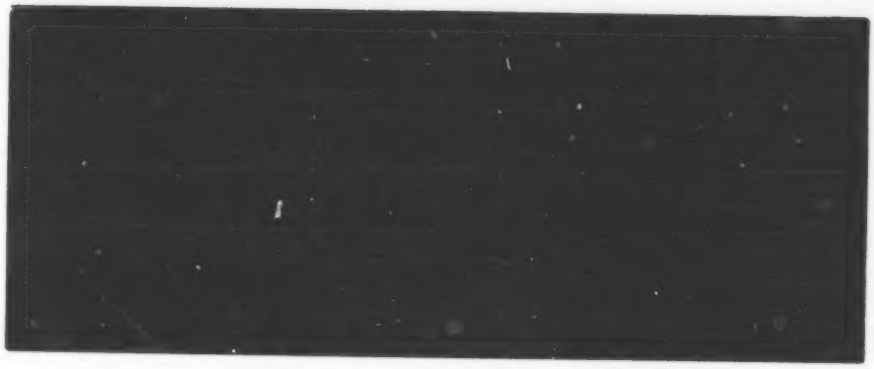

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# TESTING AND EVALUATING A "CONFORMATION DETERMINATION SYSTEM "(C.D.S.) AS A TOOL FOR USE IN THE GENETIC IMPROVEMENT OF CATTLE

FINAL REPORT

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## (A) EXECUTIVE SUMMARY

### 1. Abstract

Objectives

To complete the development of a system that will produce objective measurements of the body and hooves of cattle from a specially prepared photograph by using a computer.

Conclusions

It is possible to measure the body and hooves of cattle from a specially prepared photograph using a computer. The technical aspects of the system are highly accurate, body angles are not measured easily in any other way, and the system can be used with animals that are difficulat to handle. The accuracy system is relative to the human error of the operator.

Summary

In the fall of 1985 I was asked if I would investigate the reason for so many bulls at the Saskatoon R.O.P. Station being rejected for "Feet and Legs". My immediate reaction was to assume that the problem was one of conformation: I therefore set about ways of measuring objectively the size and shape of cattle. I am somewhat sceptical that a valid evaluation can be made visually. The first attempt to obtain accurate data was by using photographs from which distances between anatomical points could be measured. The camera translates a three dimensional subject into a two dimensional image with the result that direct readings provide inaccurate information. A professor in the College of Dentistry was, at the time, using a computer to calculate measurements of the human skull from a radiograph. The radiograph, like a photograph, is two dimensional while the skull is three dimensional. The problem with which I was faced had some similarities to that solved by the orthodontic surgeon. Subsequently, with the help of a professor from the Department of Space Engineering, it was possible to establish that the computer can provide relativly accurate information about cattle conformation from a regular thirtyfive millimeter transparency.

The conformation determination system that has been developed is referred to as CDS for short. It has proved to be highly accurate when tested on the skeleton of a cow. With living cattle the accuracy deteriorated mostly because of human error. Little by little this error margin has been reduced. Using CDS has very significant advantages over measuring cattle with a tape and a measuring stick. Joint angles can be measured; the system will produce more measurements in less time, and it is easier to make a complete conformation analysis of difficult-to-handle animals such as young bulls.

At the end of the 1985/6 test, it was found that the major cause of culling for feet and legs was due to founder or laminitis. I agreed with the lay evaluators that the same animals should be rejected but our reasons were different. That is to say, the lay evaluators concluded they were seeing animals walking badly because of poor conformation, while I was convinced that the cause was pain in the hooves. Subsequent observation enabled me to confirm that my interpretation had been a correct one. It is my considered opinion that founder or laminitis can occur in cattle that are growing rapidly. Although the observations were subjective, I am of the opinion that many of the bulls rejected for feet and legs during the 1986/87 test were eliminated because the buildup of hoof horn caused them to walk in a peculiar manner. In retrospect, I believe that many of the animals culled were culled, probably incorrectly, for this reason. Be that as it may, the discovery of founder amongst the bulls under study temporarily sidetracked the development of CDS.

Laminitis in horses has been recognized for a very long time, and it is believed that mechanical shock to the hoof makes a substantial contribution to the onset of laminitis. CDS was therefore next programmed to measure (from special photographs) the load born by the hoof in kilograms/sq cm. CDS also measures hock angles. This is important because the straighter the hock the greater will be the impact that the hoof must withstand. Animals with straight hocks are known to have a high incidence of arthritis which is one of the causes of reducing the active functional life of cattle. It is

interesting to note that the champion bull of the 1986/87 Western Agribition was an Aberdeen Angus with abnormally straight hocks. In my opinion it is extremely counterproductive to breed for characteristics known to be functionally inefficient. This is, I believe, a very retrograde move on the part of show judges. Another refinement that has been added to CDS is the capacity to calculate the average measurements or angles for any given breed, sex or age. The system can also make comparisons between measurements taken at different examinations and calculate the growth that may have occurred between the two dates.

Discussion

A body of opinion exists that feet and leg unsoundness is a problem with breeding bulls. Significant culling occurs for this reason in community pastures. Even there some bulls that are culled for lack of libido should really be eliminated because they have sore feet. Furthermore, the longevity of some breeding stock is reduced because the early appearance of joint disease adversly affects an animal's ability to forage and breed. It has become apparent to me over the past few years that conformation and laminitis are closely connected and yet we really do not understand either phenomena very well. Our present research is directed towards introducing objectivity into the evaluation of conformation and to developing systems for evaluating stressors that may predispose to or precipitate laminitis.

(B) TECHNICAL REPORT

Abstract

A system has been developed which will calculate body and limb measurements, joint angles, together with hoof measurements of cattle. The technique involves identifying certain anatomical points on the animal, taking photographs observing simple guidelines, and projecting the resulting 35mm slide onto a digitizing pad. Using the cursor and the keyboard data points are entered into the computer, calculations made and the resulting measurements stored in a database for future use. The system is accurate to within 1% under laboratory conditions. Problems arising with the posture of the animal and from inexperience on the part of the operator have been identified and addressed.

The system provides useful information about bovine conformation and permits the producer to compare the shape and size of an animal with the average for the given breed, age and sex.

Background and Objectives

In 1984/85 funding from E.R.D.A. and the Saskatchewan Horned Cattle Trust Fund was made available to study "Hoof and Limb Conformation and Soundness During R.O.P. Test".

At the initiation of this project it was apparent that objective measurements of the shape and size of the body and hooves of cattle could not be taken easily from the fractious animals that were to be studied. After several false starts and a great deal of trial and error, a system was developed which will permit a computer to generate data on conformation from a suitably prepared photograph.

Although photographic records were taken of the 1985/86 bulls, the data generated was not considered reliable. Almost continuous revisions of the measuring technique plus changes in the computer program made it impossible to attain consistency in the early days. Also at the end of the 1985/86 test, the startling discovery was made that laminitis rather than poor conformation was the reason for culling bulls in the spring of 1986. This finding sidetracked the original intent of the study for almost six months.

By the middle of 1986, it became obvious that it was necessary to consider our activities as two separate but closely related projects namely:

a) The evaluation of conformation.
b) The cause and incidence of laminitis.

The development of CDS (Conformation Determination System) continued. In addition, a separately funded, in-depth study of founder-like changes in the hooves of cattle commenced in the fall of 1987.

## Experimental Methods

In order for CDS to produce a report that is useful to the producer, it was necessary to provide the means to do so. Therefore, the conformation measurements needed to be transferred to a storage file after they had been calculated. More files had to be created to store other relevant information about each animal such as breed, sex, age, owner's name, breeding, weight gain, etc. A sub-program had to be created in order to place the information into a meaningful report for a producer. A mathematical program was produced that calculated the difference between values recorded at the beginning and end of a given period. A further sub-program has been included which will automatically average all the entries for any given breed, age, or sex. This information will permit the breeder to compare the measurement of one of his animals with the average.

The storage by the computer of the information described above takes place in a "database". Initially, a commercialy available database "dBase III" was used. Using this system convinced us that we were on the right track. However, as the database in the prototype version of CDS was filling up, the entry of data became progressivly slower and unrealistically time consuming. The decision was made to rewrite the entire program in the C Language. Apart from making CDS ten times faster, we are no longer obligated to the copywrite held by Ashton Tate, the developers of dBase III. In other words, if we are able to carry our development of CDS to its full potential, the system will be freely marketable to the industry.

The measurements of hoof size produced from the 1985/86 test were insufficienty reliable considering the increased importance associated with these measurements as a potential predisposing factor in laminitis (founder). Therefore, in preparing CDS for the 1986/87 bull test a sub-program was developed in order to measure hoof conformation from two additional closeup photographs.

The laminitis study referred to earlier has influenced the direction in which CDS has been developing. A means of storing information concerning hoof lesions has been added. It is possible to store data of 24 known lesions which may occur in any of nine regions of the hoof of eight claws in any of four levels of severity. The system, therefore, has the potential to permit us to "sort" the severity of disease by breed, age, sex as related to straightness of limb and/or the size of the hoof expressed in kilograms per square centimeter of bearing surface. CDS cannot perform this type of function at this time, but we are hoping to develop CDS-PLUS which will have full data manipulation capability.

It should be noted that data manipulation would be invaluable in unravelling problems related to lameness in dairy herds, and preliminary studies are under way at this time. There is interest to investigate the adaptation of the CDS to the horse. Discussions have taken place with individuals seeking to study conformation in swine.

## Results and Discussion

Throughout the winter of 1986/87 CDS was tested intensively. Part of these tests were theoretical and tested the geometry associated with equipment used to produce the photograph. Important tests were carried out

using the skeleton of a cow. It was found that in absolute terms there was less than 1% difference between actual measurements and the measurements produced by the computer. There was no question that under laboratory conditions CDS was as accurate as manual measurement with a tape and stick. CDS also had the advantage that its errors were consistent while those of the human being were not.

Although the R.O.P. bulls were photographed in October 1986 and again in March of 1987, the material was not processed because extensive testing for human error was still in progress. Human error arises when anatomical points are not marked correctly or if the camera placement is not precisely as described in the guidelines. Further errors creep in if the scale is not held precisely over the spine of the subject or if the animal is not correctly positioned. CDS is a system requiring the operator to follow strict rules concientiously, knowledgably and accurately.

Testing for human error could not be carried out with the unmanageable R.O.P. bulls. For this reason, cows from the University dairy herd were used as subjects. The human error of an experienced operator, repeating the evaluation ten times with each of ten animals was found to be in the order of 4%. Using ten different operators inexperienced with the technique the human error rose to 7%. It was our opinion that given the opportunity we shall improve on this performance.

Conclusions and Impact

The available literature on conformation fails to be convincing that reliable, objective and scientifically based information is available. Subjective as it may be the philosophy of Bonsma and the theory of "functional efficiency" provides us with the motivation to pursue objectivity. This motivation is enhanced by the writings of Berg and Butterworth who proclaim, very clearly, the negative influence of the show ring. Having spoken with individual producers and to audiences composed of members of the livestock industry both in Saskatchewan and Alberta, it is very clear that there is great concern about current trends in conformation. I very definitely share these concerns and believe that the accumulation of objective information will create an awareness about conformation that can only prove beneficial to the industry.

The beef and red meat industries are keenly interested in the study of conformation and feet and leg problems which include concern about the incidence of laminitis. CDS attracted a great deal of interest at the Western Agribition. I believe that some of the breed associations, although cautious, are awaiting developments with CDS. Data collection, in collaboration with beef breed associations would be a logical next step.

The most important conclusion coming from this and preceding periods of study is that the present basis for culling R.O.P. bulls for "feet and legs" is inappropriate and that suitable guidelines should be developed for R.O.P. stations. The wide use of CDS should be encouraged at all R.O.P. or similar bull "fitting" operations.

(C) PAPERS AND PRESENTATIONS

1987

August 14th Canadian Holstein Breed Association, Brantford, Ont
"A Conformation Determination System" (Discussion/Demonstration)

August 20th World Veterinary Congress Montreal
"A method for measuring the conformation of cattle from a 35mm transparency with a digitizing pad and computer".

August 23rd Royal Netherlands Herdbook Society, Ahrnem, Netherlands.
"A Conformation Determination System" (Discussion/Demonstration)

August 28th Danish Meat Research Institute, Roskilde, Denmark
"A Conformation Determination System" (Discussion/Demonstration)

August 29th Royal Agriculture and Veterinary College, Copenhagen, Denmark.
"Bovine Laminitis"
"Surgical Treatment of conditions affecting the digital region"

Sept 2nd Swedish Association for Livestock Breeding and Production
Eskiltuna, Sweden
"A Conformation Determination System" (Discussion/Demonstration)

Sept 3rd Experimental Station, Veterinary Research Institute, Skara, Sweden,
"A Conformation Determination System" (Discussion/Demonstration)

Sept 5th Institute of Animal Science, Copenhagen, Denmark
"A Conformation Determination System" (Discussion/Demonstration)

Sept 8th Royal Agriculture and Veterinary College, Copenhagen, Denmark
"Anatomical and Conformational Considerations in Cattle"

Sept 10th British Veterinary Association Congress, Warwick, UK
"Laminitis in Cattle"
"A veterinarians Role in Conformation Determination"
"Surgical Treatment of Bovine Digital Conditions"
"Diagnosis of Diseases of the Digital Region of Cattle"

Sept 11th Milk Marketing Board
British Friesian Cattle Society
Joint Board meeting Scotsbridge House, Rickmandsworth,U.K.
"A Conformation Determination System" (Discussion/Demonstration)

Dec 18th National Pig Development Co Ltd
Consultation on Conformation Determination Techniques

Dec 21st Saskatchewan Dairy Producers Association (Board)
"Conformation and Lameness in Dairy Cattle"

1988

Jan 27th — 1988 Penn Annual Conference (Pennsylvania)

"Sub-clinical Laminitis - fact or fiction"
"Applied Anatomy, Surgical and Other Procedures"
"Diagnosis and Control of Bovine Lameness - personal perspective"
"The determination of Bovine Conformation - Veterinary Involvement in Genetic Improvement"
"Practical Demonstration"

Jan 29th — National Bull Test Seminar
"Effect of Ration on Feet and Legs"
"Identification of Feet and Leg Problems"
(Requested for publication in Cattlemans Corner, GRAINEWS)

Feb 5th — Textbook of Large Animal Surgery. Pub Williams & Wilkins
Chapter 6 The Integumentary System Page 154 to 220

Summary

Dairy breeders consider the measurement of conformation by objective means too time consuming and that their present system is adequate for their needs. They are very keenly interested in lameness, sub-clinical laminitis and conformational or stress factors which may be implicated in these problems. There was one exception regarding disinterest in the use of CDS. Both the Milk Marketing Board in the UK and the Swedish Association for Livestock Breeding and Production would like to test CDS in progeny testing bulls.

My visit to Denmark was aimed at obtaining more information regarding the study of the histopathology of laminitis. Workers at the Royal Agricultural and Veterinary College are world leaders in this field and their techniques are being introduced into our present studies with beef steers. The trip to Denmark also revealed interest in the use of CDS to measure an animal carcass. This aspect of the use of CDS has stimulated the interest of Dr. Jack Newman and his co-workers at the Ag Canada Research Station at Lacombe, Alberta to whom CDS has been demonstrated. We have been asked to modify CDS for carcass measurement.

(D) VERIFIED STATEMENT OF EXPENDITURES.

To be supplied directly by the University of Saskatchewan.

(E) PERSOMMEL INVOLVED AND % OF TIME

| | |
|---|---|
| Philip BERG | 100% |
| Michael OGUNYELE | 10% |
| Paul GREENOUGH | 5% |

(F) EQUIPMENT PURCHASES.

NONE